**Partnership for**

**Science & Engineering Practices**

**Summer Institute 2013**

Dimmitt Middle School

August 20, 2013

**Engineering:**

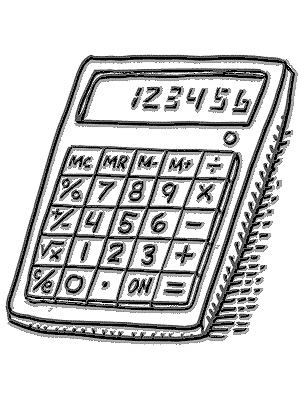
Participant Notebook



A Math and Science Partnership Award from Washington’s Office of Superintendent of Public Instruction

Our Initial Ideas about Engineering

|  |
| --- |
| What is your background as a learner of Engineering? |
| What is your experience as a teacher of Engineering? |
| What are some important terms |

**Is it Technology?**

Which of the following are examples of TECHNOLOGY?

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **\_\_\_\_** | Laptop | **\_\_\_\_** | Toilet |  |
| **\_\_\_\_** | Stapler | **\_\_\_\_** | Volcano |  |
| **\_\_\_\_** | Written language | **\_\_\_\_** | Farming |  |
| **\_\_\_\_** | Guitar | **\_\_\_\_** | Lamp |  |
| **\_\_\_\_** | Lightning | **\_\_\_\_** | Pencil |  |
| **\_\_\_\_** | Habitat | **\_\_\_\_** | Seeds |  |
| **\_\_\_\_** | Sticky note | **\_\_\_\_** | Cell phone |  |
| **\_\_\_\_** | Projector | **\_\_\_\_** | Mars |  |
| **\_\_\_\_** | Tree | **\_\_\_\_** | Telescope |  |

**Describe your rule for something to be considered TECHNOLOGY. Use evidence and reasoning to support your claim.**

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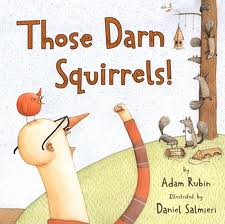
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Engineering in the NGSS

Insert Appendix I HERE (p. 1-7)

Those Darn Squirrels

Identify places in the story where Mr. Fookwire or the squirrels engage

in one of the three components of Engineering Design.

|  |
| --- |
| 1. **Defining and delimiting engineering problems** involves stating the problem to be solved as clearly as possible in terms of criteria for success, and constraints or limits. |
| 1. **Designing solutions to engineering problems** begins with generating a number of different possible solutions, then evaluating potential solutions to see which ones best meet the criteria and constraints of the problem. |
| 1. **Optimizing the design solution** involves a process in which solutions are systematically tested and refined and the final design is improved by trading off less important features for those that are more important. |



Use the image from the book *Those Darn Squirrels* to think about Engineering Design

Define the **problem** the squirrels are attempting to solve:

Identify **constraints** (needs):

Identify **criteria** for success (wants):

Brainstorm some other **solutions** than the one pictured above:

We know that this solution did not solve the problem. What might the squirrels do to refine their solution?

Video Reflection- Liam’s Story

After hearing about Liam’s story- read the text below from A Framework for K-12 Science Education and reflect on the questions.

**The Influence of Engineering, Technology, and Science on Society and the Natural World**

*Together, advances in science, engineering, and technology can have—and indeed have had—profound effects on human society, in such areas as agriculture, transportation, health care, and communication, and on the natural environment. Each system can change significantly when new technologies are introduced, with both desired effects and unexpected outcomes. (NRC, 2012, p. 210).*

How might Liam’s story relate to the influence of Engineering, Technology, and Science on Society?

How might stories, such as Liam’s, be used in classroom instruction?

What do you want to remember from Liam’s story that may help guide your own understanding of engineering or your instruction about engineering?

Video Reflection- Toilet Challenge

After hearing about the Toilet Challenge- read the text below from A Framework for K-12 Science Education and reflect on the questions.

***The Interdependence of Science, Engineering, and Technology***

*The fields of science and engineering are mutually supportive, and scientists and*

*engineers often work together in teams, especially in fields at the borders of science and engineering. Advances in science offer new capabilities, new materials, or new*

*understanding of processes that can be applied through engineering to produce advances*

*in technology. Advances in technology, in turn, provide scientists with new capabilities to*

*probe the natural world at larger or smaller scales; to record, manage, and analyze*

*data; and to model ever more complex systems with greater precision. In addition,*

*engineers’ efforts to develop or improve technologies often raise new questions for scientists’ investigations. (NRC, 2012, p. 203)*

How does the Toilet Challenge relate to ***The Interdependence of Science, Engineering, and Technology?***

How might stories, such as the Toilet Challenge, be used in classroom instruction?

What do you want to remember from the Toilet Challenge that may help guide your own understanding of engineering or your instruction about engineering?Constraints and Criteria

**Criteria** in A Framework for K-12 Science Education

The engineering design process begins with the identification of a problem to solve

and the specification of clear goals, or criteria, that the final product or system

must meet. Criteria, which typically reflect the needs of the expected end-user of

a technology or process, address such things as how the product or system will

function (what job it will perform and how), its durability, and its cost. Criteria

should be quantifiable whenever possible and stated so that one can tell if a given

design meets them.

Craft a “student friendly” definition of **Criteria**

**Constraints** in A Framework for K-12 Science Education

Engineers must contend with a variety of limitations, or constraints, when

they engage in design. Constraints, which frame the salient conditions under

which the problem must be solved, may be physical, economic, legal, political,

social, ethical, aesthetic, or related to time and place. In terms of quantitative measurements,

constraints may include limits on cost, size, weight, or performance,

for example. And although constraints place restrictions on a design, not all of

them are permanent or absolute.

Craft a “student friendly” definition of **Constraints**

Considering Constraints and Criteria

If you were given the above request, what questions would you have?

Build a free-standing structure that supports one marshmallow

**Questions about Constraints (needs):**

**Questions about Criteria (wants):**

Marshmallow Challenge (Engineer Page)

**Role:** For the next 18 minutes you will be engaged in designing a solution to the Marshmallow Challenge

**Problem:** Design the tallest free-standing structure that will support a marshmallow using only 20 pieces of dry spaghetti, 1 meter of tape, 1 meter of string, and 1 marshmallow.

You have a pair of scissors to be used as a tool.

You may use the space below to capture any evidence of your Engineering Design process:

Marshmallow Challenge (Anthropologist Pages)

**Role:** for the next 18 minutes you will observe the engineers and gather evidence of their use of the Engineering Design process.

Pick 1 of the next 3 pages to guide and organize your observations about a component of design.

|  |  |
| --- | --- |
| **TRAIT** | **Evidence** |
| **B. Develop Solutions** | |
| Brainstorm/explore multiple solutions |  |
| Apply scientific ideas to solve design problems |  |
| Use systematic methods to compare different solutions to see which best meet criteria and constraints |  |
| Creates a legible plan, model, diagram, description of solution |  |
| **TRAIT** | **Evidence** |
| **C. Optimize Solutions** | |
| Test solutions |  |
| Make observations and/or measurements to produce data to test a design solution |  |
| Revise solutions |  |
| Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success |  |
| Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem |  |
| Can redefine the problem or generate new solutions to replace an idea that just isn’t working out |  |
| Arrives at an optimal design |  |
| **TRAIT** | **Evidence** |
| **D. Other Skills and Practices** | |
| Collaborates effectively during Engineering Design process |  |
| Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem |  |
| Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts. |  |
| Displays stamina in revising solutions several times |  |

### Title: MLB Actively Seeking Suitable Protective Headgear For Pitchers; Nothing Imminent

**By:** multiple

**Source:** Sports Business Daily

**Date:** May 9, 2013

**Directions:** As you read the text, identify constraints and criteria for success.

Annotate the text with:

* Constraint (needs)
* Criteria (wants)

State the Problem:

MLB Senior VP & General Counsel/Labor Dan Halem yesterday indicated that nothing is "imminent as far as baseball giving its approval to protective headgear" for pitchers, but the league is "very active in seeking a product that it can approve," according to Willie Weinbaum of ESPN.com.

MLB is "considering doing testing of different products to determine whether at high speeds such as 90 or 100 miles per hour, a product would protect a pitcher’s head." The league has "tested three such products so far," but none of these products "met the standard." Protective gear company EvoShield, which "provided those prototypes, is working on refining the product to perhaps pass the test," while Unequal Technologies has "provided its own test data to baseball but that data did not meet baseball’s approval."

The issue was heightened after Blue Jays P J.A. Happ took a line drive to the head on Tuesday. Halem said that he does "not want to give pitchers or anybody a false sense of security ... if it’s not really providing protection." Weinbaum noted there also is a "hold up" in getting protective headgear approved "in terms of the practical" aspects. Pitchers "don’t want something that’s bulky or that has a lot of weight, or that looks bad." Halem said that to the "best of Major League Baseball’s knowledge," there are "no pitchers who are wearing specially padded caps; they’re just wearing the standard-issue cap." Weinbaum noted nobody has "taken it upon himself to wear it," including D'Backs P Brandon McCarthy, who "suffered life-threatening injuries and needed brain surgery after he was hit by a line drive in September."

Yankees P CC Sabathia indicated that he had "never been hit in the head, but if he saw a product that he found to be satisfactory, he would wear it because it would be a measure that wouldn’t interfere with what he’s doing and might provide protection" (*"Baseball Tonight," ESPN.com, 5/8*).

MLBPA Exec Dir Michael Weiner said of pitchers wearing protective headgear, "If someone could come up with a product that would work, guys would be in favor of it." Tigers P Darin Downs said, "Nobody's going to wear one unless it feels comfortable. I'd totally wear one if something felt comfortable and didn't hamper me from doing my job." USA TODAY's Paul White notes Downs "received two such hats from a company this offseason," but neither "sat right on his head."

Meanwhile, protection beyond the current cap shape "surely would meet with more resistance." Giants P George Kontos: "If anything's over my head or face or anything like that, it would be a little bit too much of a distraction" (***[USA TODAY, 5/9](http://www.usatoday.com/story/sports/mlb/2013/05/08/ja-happ-line-drive-head-injury-protective-gear/2145637/" \t "_blank)***). Mariners P Aaron Harang said, "I don't think it's a problem that's easily solved. I know a lot of people want pitchers to start wearing helmets. It's a good idea in theory, but I don't know how practical it is" (*AP, 5/8*). Mets P Shaun Marcum: "If it's going to add weight or possibly alter my mechanics, I don't want anything to do with it. I'll take my chances."

Mets P LaTroy Hawkins: "It's the dumbest thing I've ever heard. ... Can you imagine going out there and trying to pitch with a football helmet on?" (*N.Y. TIMES, 5/*9). ESPN's Dan Le Batard said of pitchers wearing helmets, “I guess that would be the solution ... but man, that would look awkward. Everybody out there looks like John Olerud” (*“Dan Le Batard Is Highly Questionable,” ESPN2, 5/8*). ESPN.com's Buster Olney said, "There’s always that sort of old-school resistance that you see in situations like this." He noted in the aftermath of minor league coach Mike Coolbaugh dying in '07 after being hit with a line drive, MLB "mandated that base coaches wear those helmets." Some coaches initially thought it would "make them look silly," but fans now "don’t even notice, and no one talks about it." Olney: "You wonder if that’s the type of thing that could happen with padded caps once Major League Baseball gets a product it will approve" (*"Baseball Tonight," ESPN.com, 5/8*).

CBSSports.com's Scott Miller said there is "not a lot that can be done" outside of a possible protective lining inside caps to protect pitchers. He noted Happ was hit "just below where the protective lining would’ve been if it would even have been worn." It also is "too unwieldy to pitch" with a helmet on (*“Lead Off,” CBS Sports Network, 5/8*). ESPN’s Michael Wilbon said, “You’ve got to do whatever you can to the cap, whether it’s a liner all the way around. I am not saying you can protect them 100% ... but you’ve got to do something to the pitcher's cap and put whatever you can in it to protect the pitcher as much as you can.”

ESPN’s Tony Kornheiser said, “This is a safety issue. You make sure that the pitchers -- even if you put them in kevlar, whatever you do -- all pitchers have to do it all the way up and then the pitchers will adapt to the circumstances" (*"PTI," ESPN, 5/8*). CBS' Jim Rome said, "MLB has been investigating alternatives like a padded hat lining, and they better pick up the pace because the next guy may not be leaving on a stretcher but in a pine box” (*“Rome,” CBS Sports Network, 5/8*).

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What challenges did you have in identifying the constraints and criteria?

What ideas do you have for solutions to this problem?

What thoughts do you have about how to help your students identify Constraints and Criteria for Engineering Design Solutions?

Readings on Engineering

= Insert Framework pages 221-225

= Insert Cary Sneider article- Core Ideas of Engineering & Technology